RSMS-4 Design and Development — Software

Outputs

- System Requirements Document (http://www.its.bldrdoc.gov/home/programs/rsms-4/software_sys_req.pdf).
- Use-case Statement that describes how the software will operate from the user standpoint.
- Architectural design that documents the overall structure of the software.
- Data acquisition and analysis software.

The fourth generation of the Radio Spectrum Measurement System (RSMS-4) will critically depend on powerful new data acquisition and processing software to meet the greatly expanded system capabilities (see figure). The new software encompasses many of the strong features of previous generations, as well as incorporating several new features that improve on the current system and allow for substantial future growth.

Major goals in the development of the new software are the ability to easily expand measurement and analysis capabilities and to modify the equipment configuration in the field.

The ability to modify and expand is accomplished by taking a highly modular approach, using an object-oriented (OO) design technique. The software contains a relatively static core program that utilizes various dynamic measurement and instrument modules. By establishing well-defined interfaces and encapsulating the code into dynamic link libraries (DLLs), new measurement techniques can be added without modifying or re-compiling the core program. By establishing command/query interfaces and encapsulating into DLLs, it is also possible to add new models of equipment without the need to change existing measurement code modules. While this requires the use of functional features common to each general category of equipment, the ability to use specialized attributes is also possible by tailoring specialty measurements to make use of specific models.

Hardware flexibility is also enhanced because it is possible to use a variety of instrument models for the same type of measurement via a well-established interface to the general command/query modules. Also integral to the capability for flexible hardware configurations is the ability of the user to dynamically designate the hardware configuration — from the fully equipped measurement vehicle to an abbreviated “suitcase” system. The user also can designate the manual control of some devices and automated control of others.

A script language that gives the user a means to build custom routines for specialized signal measurements provides flexibility in the field. The scripting module utilizes a standard editor, which allows the user to enter specifically defined command text that is interpreted for execution on the targeted instruments. The language is generic for the different generic instrument types (e.g., spectrum analyzer, digital oscilloscope, etc.), and is interpreted in relation to the specific instrument model targeted for execution.

Other features of the new software include:
1) flexible file structures,
2) incorporation of calibrations into the data file,
3) remote measurement/control capabilities,
4) scheduling of measurements,
5) re-measurement capabilities, and
6) high speed signal digitization.

The output data-file format accommodates changes to stored information by adding version markers; these identify the structure of the data and allow backward compatibility despite change. Each module containing the data is responsible for packaging during data writes, parsing the information (according to the version marker) during reads, and documenting the data structure by writing the format for each version to an ASCII file. This allows future format modifications without having to change the core code module. The new file structure adds calibration information into the data files, along with system configuration, measurement parameters, and instrument settings.

The setup and execution of RSMS-4 measurement procedures can be remotely controlled and monitored through the Internet. This minimizes field time for highly skilled employees, permits more opportunistic measurements and improves data quality, and allows the acquired data to be promptly processed in an optimal work environment.

While previous RSMS generations had the capability for sequential, automated execution of measurements, the 4th generation has the added features of a scheduler. This provides for triggering of measurement routines by external events, repetition and prioritization of a predetermined schedule of planned measurements, and scheduled automation of diagnostic, re-adjustment and calibration procedures.

To meet the requirements for expanded capabilities, ITS engineers are developing software for the 4th generation Radio Spectrum Measurement System (photograph by F.H. Sanders).

Because system configuration, measurement parameters, and instrument settings are stored as a part of each data file and linked to the specific measurement routines, it is now possible for system operators to examine measured data and request re-measurement of that data under the same system conditions.

Also incorporated into the new software is the improved capability for digitization of signals in wideband predetection format. This significantly improves the capabilities for software signal processing in ways that are not possible through traditional analog means — for example, very sharp filtering techniques or determination of signal modulation characteristics. Previously, most signal measurements merely extracted the signal magnitude information. With digitization of the raw predetection signal, all of the signal information is retained, allowing the same signal to be processed in many different ways.

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